DESIGN MEMORANDUM

ON

NANTUCKET HARBOR, MASSACHUSETTS

(MINOR REHABILITATION - EAST JETTY)

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

WALTHAM, MASSACHUSETTS

4 MAY 1962

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM 54, MASS.

ADDRESS REPLY TO:
DIVISION ENGINEER

4 May 1962

REFER TO FILE NO. NEDGW

SUBJECT: Design Memorandum on Nantucket Harbor, Massachusetts (Minor Rehabilitation - East Jetty)

TO: Chief of Engineers
ATTN: ENGCW-E
Department of the Army
Washington 25, D. C.

1. In accordance with EM 1110-2-1150, 1151 and 1152 Engineering and Design, Definite Project Studies, dated 15 January 1962 and letter ENGCW-E, dated 24 August 1960, Subject: Rehabilitation Projects - Definite Project Studies, there are inclosed ten (10) copies of the design memorandum on the subject project. The work involved is the repair of the east jetty at Nantucket Harbor, Massachusetts, the cost of which falls within the scope of projects defined as minor rehabilitation projects.

2. In accordance with the above-referenced authority, the design memorandum is forwarded for review and approval. Funds in the amount of $110,000 have been allocated in FY 1962 for rehabilitation of the east jetty at Nantucket Harbor, Massachusetts. Additional funds in the amount of $140,000 are required. Recommendation with respect to funding this amount will be made by separate correspondence. Work is scheduled to be advertised in May 1962.

1 Incl (10 cys)
as

OTTO J. ROHDE
Colonel, Corps of Engineers
Acting Division Engineer

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 TRAPELO ROAD
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NEDGW

DESIGN MEMORANDUM ON
NANTUCKET HARBOR, MASSACHUSETTS
(MINOR REHABILITATION - EAST JETTY)

PERTINENT DATA

1. A summary of the physical features and costs of the repairs to the existing Federal east jetty at Nantucket Harbor, Massachusetts, is as follows:

Features	Present Estimate (1962)
Repairs to existing east jetty to restore structure to project purpose.	$250,000

PROJECT AUTHORIZATION

2. The existing project for the improvement of Nantucket Harbor was authorized by the River and Harbor Act of 1880 and supplemented by the River and Harbor Acts of 1886 and 1945.

3. The project as authorized provides for a channel about 1.6 miles long, 15 feet deep, without prescribed width, through the bar at the entrance, two riprap jetties, one on the east side 6,987 feet long and one on the west side 5,755 feet long. The west jetty was authorized in 1880 and the dredging and east jetty was authorized in 1886. Authorizations for these improvements were not subject to any requirements of local cooperation.

4. The River and Harbor Act of 1945 authorized further improvement of the harbor to provide for an anchorage 15 feet deep, 300 to 1,100 feet wide in the harbor and a fairway 15 feet deep, 200 feet wide on the west side of the anchorage. This improvement was authorized subject to the conditions that local interests furnish free of cost to the United States suitable spoil disposal areas for new work and subsequent maintenance, when and as required; contribute the sum

of $31,500 in cash or dredging; and hold and save the United States free from all claims for damages which might result from the improvement. In fiscal year 1957 funds were allocated for construction of this project modification. Subsequent to the appropriation, local interests indicated that the changing navigation needs in the harbor rendered the 15-foot anchorage provided by the 1945 project modification unnecessary and expressed a desire that the funds appropriated be used for jetty protection inside the harbor, and also to raise the existing jetties at the entrance. A study is presently authorized to determine whether the existing project should be modified to provide for a jetty inside the harbor. Additional height to the existing entrance jetties can be provided under existing project authorization if found to be feasible and economically justified.

5. In view of the opposition by local interests toward the 1945 modification as expressed officially by the Board of Selectmen, the work was placed in the inactive category in 1957. The latest approved estimate of cost for this work is $193,000 (1957 level) of which the local cash contribution is $31,500.

6. All work on the jetties at the entrance was completed by 1907 and all improvement dredging was completed by 1915. The total costs to date incurred in connection with the existing project are $457,000 for new work (divided approximately as follows: west jetty $135,000, east jetty $189,000 and dredging $133,000) and $312,000 for maintenance.

LOCATION

7. Nantucket Harbor is on the north side of Nantucket Island, which lies in the Atlantic Ocean about 25 miles south of Cape Cod. The approach to the entrance to the harbor is through the relatively deep water of Nantucket Sound. The entrance channel, 300 feet wide and 15 to 20 or more feet deep, lies between converging jetties, and extends from deep water in the sound southerly to and around Brant Point into Nantucket Harbor.

TRIBUTARY AREA

8. Nantucket Island has a land area of about 68 square miles and a year-round population of about 3,700. The commercial and residential interests center in the village of Nantucket. The largely increased summer population is spread to colonies in other parts of the island. The principal industries are fishing, and catering to the needs of summer visitors. There is little agriculture and no manufacturing.

Passengers and freight are carried on the steamboat which plies regularly between the island and Woods Hole on Cape Cod. Cargoes are also carried by contract and private carriers at irregular intervals. There is no railroad on the island. The outlying summer settlements are connected with the village center and commercial harbor by improved roads.

INVESTIGATIONS

9. History of the Jetties. - The tidal inlet at Nantucket has been the subject of reports since 1829. The report of 1829 advocated dredging a channel through the bars. It was believed at that time that a dredged channel would be self-maintaining without jetty protection. The controlling depth over the bar at the entrance was then 6 feet at mean low water. On the basis of the 1829 report appropriations were made for dredging and between 1829 and 1832 about $45,000 was expended for that purpose. However, no beneficial effect was attained since the channel filled in rapidly. Records do not show any further attempt to improve the entrance without jetties.

10. The first project for jetty construction was adopted in 1880 when construction of the west jetty was started. This project was based on a report made in 1879 printed in House Document No. 18, 45th Congress, 2d Session which contemplated a jetty having a top height of 5 feet above mean low water, triangular in section for a distance of about 4,000 feet and then 4 feet wide on top for the outer 2,500 feet with side slopes throughout of 1 on 1. The purpose of the jetty was to concentrate the ebb tide to encourage scour in the entrance channel to attain a depth of 12 to 14 feet, and to prevent littoral drift from filling in the channel. It was considered at the time that a jetty on the east side of the harbor might be necessary. Dredging was not contemplated. During construction of the west jetty, careful observations were made to determine the effect of the structure with the view that if the west jetty failed to produce the desired scour, the east jetty would be started. By 1885, 3,955 feet of the west jetty was constructed with no appreciable affect on the depth of water in the channel. Based on a study made in 1885, the results of which are contained in the Annual Report of the Chief of Engineers of 1885, the project was modified to provide for construction of the east jetty. Under the new plan, a location and design for the east jetty was adopted and a 15-foot channel was to be obtained by dredging, if found necessary. The east jetty was to have the same trapezoidal full section as the west jetty for a distance of 2,500 feet from shore and then a half-tide section for the remaining distance of about 4,500 feet out to the 15-foot contour, a total distance of about 7,000 feet. Cross sections are shown on Plate 1.

11. Construction of the east jetty began in April 1886 and was continued on until 1907 as appropriations were received. By that time the jetty was constructed to full cross-section for a distance of 834 feet and at half-tide section for a distance of 6,153 feet. The total length constructed was 6,987 feet, which is also the present length of the jetty. Between 1897 and 1900, the west jetty was extended an additional 1,000 feet of which 600 feet of the outer end was brought to full section and 400 feet to half-tide level. The total constructed length of the west jetty was 4,955 feet. Since 1900, no work has been attempted to complete the remaining 800 feet of the authorized and contemplated length of 5,755 feet for the west jetty. Completion of the west jetty was placed in an inactive status in 1952.

12. Despite the completion of the west jetty to its present dimensions in 1900 and all but the outer 2,147 feet of the east jetty by 1904, the least depth of the channel secured by tidal scour along had not increased by 1905 beyond the 8 feet reported in 1894. Accordingly, dredging was considered necessary to achieve the desired channel depth. In 1905, dredging was performed and a channel 12 feet deep, 200 feet wide was secured. Additional dredging operations were carried on in 1910, 1914 and 1915 resulting in a channel 15 feet deep, and generally 450 feet wide. Since 1915 the channel has been maintained to a width of 300 feet.

13. Jetty Maintenance. - Maintenance work on the east jetty was first performed in 1917 when the stone mound for the light at the outer end was reconstructed at a cost of $5,300 for the placement of 1,793 tons of stone. The section adopted for the east jetty in 1885 was 4 feet wide on top, the same as the outer end of the west jetty. Probably due to washing down by wave action, the section shown on a drawing dated 1922 is 6 feet wide on top. Subsequent repairs were made to this dimension. In 1926 repairs were made to the east jetty covering all but the outer 300 feet at a cost of about $42,000. The east jetty was again repaired in 1936 - 1937 at various points involving the placement of about 15,900 tons of stone at a cost of about $57,000. No repairs have been made on the east jetty since 1937. Except for some stone placed in 1894 to counteract settlement in the structure, the west jetty has not been repaired since completion of new work performed in 1900. The jetty has suffered some damage since that time. However, the present condition of the west jetty is fair to good and can be repaired with ordinary operations and maintenance funds. Consequently no further consideration will be given to rehabilitation of this structure.

14. Dredging Maintenance. - Since 1915 when the present project channel of 15 feet was secured, maintenance dredging in the entrance channel was performed 4 times as follows:

Year	Location	Volume (c.y.)	Amount
1925	Inner end of entrance channel	23,000	$13,862
1929-1930	Entire entrance channel	86,333	$32,334
1936-1937	Inner and outer bars	131,666	$12,706(1)
1959	Entrance channel	70,547	$35,014(1)

(1) Performed by Hopper dredge.

On the basis of the above record, maintenance dredging is required about once every ten years involving the removal of about 7,000 cu. yds. annually. Although maintenance was performed by hopper dredge, which in this area is substantially less than if it were accomplished by contract, it is estimated that the average annual maintenance cost under contract operations would be about $15,000 annually.

15. Suitability of Design as Constructed. - The jetties at the entrance were constructed to provide a means of creating scour to provide and maintain an adequate entrance channel and to trap littoral drift from filling the channel. In addition to the above purpose the jetties also served as breakwaters and provided in some measure a safe entrance to the harbor, although the constructed height (half tide level) of the east jetty is considered by navigation interests to be somewhat less than that desired. Since their completion, the jetties have served the purpose intended. This is evidenced by a comparison of rate of shoaling prior to the construction of the jetties when the record indicates that a 17-foot dredged channel nearly filled to the natural depth of 6 feet after one storm with the record of the minor rate of shoaling since completion of the jetties and the initial dredging in 1915. The present condition of the jetties and the amount of repairs required since their completion indicates the suitability of the design of the structures. The west jetty has never been repaired since 1900 and is presently in fair to good condition. The east jetty has been subject to repair 3 times since 1907. Stone losses in the period 1907 to 1961 amounted to about 37,000 tons or an average of about 700 tons/year.

16. The original study in 1885 for the east jetty considered a height and a top width sufficient to control the tidal prism to create scour and to withstand the effect of ice. The effect of wave attack was not considered. In view of these considerations 834 feet of the inshore end of the east jetty were constructed to a full section having a top width of 4 feet at elevation +5 feet above mean low water and side slopes of 1 on 1. The remaining length was constructed to a half-tide section at elevation of +1.5 feet above mean low water. Stone sizes used were 1 to 1½ ton cover stone over a core of smaller stone weighing 5 to 200 lbs. Even though the structure effectively withstood serious wave damage, it is considered that heavier cover stone then originally placed should be used in rehabilitation work.

17. Data and Criteria Used in the Design Developed for Repair of the East Jetty. - Wave refraction studies were not made to select a design wave. It was considered that a design wave could be reasonably established from hindcast statistics.

18. Hindcast statistics published by the Beach Erosion Board (TM No. 55) indicate waves from the NE off Cape Cod up to 30 feet in height. Inasmuch as the depth of water off the structure would not support waves of 30 feet, the design wave has been determined on the basis of water depth.

19. Soundings just off the jetty to the east indicate a depth averaging about 5 feet at mean low water. The mean range of tide is 3.0 feet and storm tides of 4.0 feet can be expected. Therefore, the depth available to support a wave approaching the jetty is 9.0 feet. Waves over 7.0 feet would break in 9 feet of water. The predominant waves and most severe storms originate from the northeast quadrant. Although there are shoal areas between Monomoy Point and Great Point, waves of 7 feet in height and greater could be sustained at the depth of these shoal areas. Consequently, the largest wave that could be sustained before breaking at the site of the jetty is taken as 7.0 feet.

20. This jetty, if built to a height that would stop all overtopping, would be economically unfeasible. Various crest elevations were considered to determine what height would reduce a 7-foot wave to one that would not be damaging to ships entering the channel. From Figure 76 in Technical Report No. 4, it was determined that in a depth of 9 feet, a crest elevation of +5 feet MLW (jetty height of 10 feet) would reduce a 7-foot wave seward of the structure to a wave height of 2 feet on the protected side of the structure. The crest elevation of +5 feet above mean low water is the same as recommended in 1880 by the District Engineer.

21. However, in view of the cost involved in raising the major portion of the jetty to an elevation of +5 feet MLW and the relative effectiveness of the jetty at its present height of +1.5 feet MLW in maintaining the channel, an elevation of +3.0 feet above mean low water, the height of mean high water, was selected in the rehabilitation plan. Such a height is considered reasonable for the following reasons:

a. Cost of rehabilitation will be kept within reasonable limits.

b. The limited additional height of 1.5 feet (from half-tide to full tide elevation) will be more effective in controlling flow and promoting scour thus reducing maintenance cost for dredging.

c. More protection will be provided for the entrance channel.

d. The need to strengthen the stability of the structure by use of larger cover stone requires additional 1.5 feet of height to the jetty.

e. Tidal flow over the east jetty which is very troublesome to ships navigating the channel, tending to set them over on the west bank of the channel will be minimized.

22. The design criteria used to compute the weight of stone required for the maximum wave are as follows:

Design wave - 7.0 feet (breaking wave)
Unit weight of stone in pound - cu. ft. = 165
Height of jetty - +3.0 feet above m.l.w.
Side slope - 1 on $1\frac{1}{2}$
K_d factor - 2.5

Based on the above criteria the weight of cover stone is computed from the WES-Hudson formula as follows:

$$Wr = \frac{w_r H^3}{K_d (Sr-1)^3 \text{ Cot } a}$$

$$= \frac{165 (7)^3}{2.5 (2.57-1)^3} 1.5$$

$$= 2 \text{ tons.}$$

23. At a top elevation of +3.0 feet above mean low water, a 7-foot wave approaching the jetty at storm tide would break above the structure. Most of the energy would therefore be dissipated and it would appear that damage from this wave would be less than a wave occurring sometime between mean high water and mean low water. Such waves would break immediately on top or against the slope. At low water the maximum depth available to support a wave is about 5 feet and at average high water 8 feet. Waves that would break at the structure during these periods are 4 and 6 feet respectively. Application of the WES-Hudson formula, using a K_d factor of 2.5, would result in stone size smaller than that determined for the 7-foot wave. It is therefore concluded that a design stone size of 2 ton is adequate and will provide for a satisfactory factor of safety. The head of the jetty was rebuilt in 1917 and since that time has remained in a satisfactory condition. No work is contemplated at the head of the jetty.

24. In order to provide for proper interlocking of the stone it is considered that cover stone should range from a size equal to 80% of the design size of stone, or $1\frac{1}{2}$ tons, to about 20% above design stone size, or $2\frac{1}{2}$ tons. No more than 25% of stone less than 2 tons will be permitted. Stone sizes greater than design stone would be limited by pay lines established. This range of stone size will provide for adequate strength and permit sufficient flexibility in construction procedure to attain proper interlocking between the new stone and the existing stone. In the relatively few instances where use of design stone will exceed proposed height and permitted tolerance, existing stone will be moved and reset so that proper interlocking will be achieved.

25. Necessity For Repairs. - There is no indication that the need for the jetties at the entrance to Nantucket Harbor will change. Since the existence of the community on the island is dependent upon its harbor for communication and supplies to and from the mainland and since its primary industry and economy is dependent upon a protected harbor with a safe approach channel with adequate depths, it is necessary and essential that the jetties be maintained in a condition to perform the purpose for which they were constructed. Without proper jetties a navigable channel of sufficient depth to serve the island would be difficult to maintain at reasonable cost. It is considered that the height to which the east jetty was constructed is critical and is the minimum height that should be tolerated. Further deterioration of the jetty is not advisable.

PROJECT PIAN FOR REHABILITATION

26. The plan to rehabilitate the east jetty is shown on Plates 2 and 3 and 4. Basically, it provides for placing a cover of stone ranging from 1½ to 2½ tons on or around the existing structure. The smaller stone will be used to fill the voids between the irregular existing stone and the new cover stone, and to provide a means of interlocking stone properly. In order to keep the cost of rehabilitation to a minimum, the existing cross sectional area of the jetty will be used as much as possible. Consequently, deviations will be made from the centerline of the original structure. It is not considered that these deviations will significantly affect the appearance or effectiveness of the structure. In those areas where existing jetty elevations do not permit the placement of a new stone, the existing stone will be moved to the extent absolutely necessary for stability of the toe of slope, and reset together with new stone to attain good interlocking.

27. For 834 feet of the inshore end of the jetty, the plan provides only for repair between station 5+00 to 6+50 at elevation +5 feet above mean low water, a top width of 6 feet, and side slopes of 1 on 1½ as shown on Plate 3. The remaining length of the jetty will be constructed to the same cross sectional dimensions except for a top elevation of +3 feet above mean low water.

COST ESTIMATE

28. The estimate of cost for repairing the east jetty is based on volume of stone to be placed within the proposed cross sectional area as determined from a cross section survey of the existing structure made in April 1961 and unit prices obtained during 1961-1962 for similar work. The estimate of cost is as follows:

Contract	
15,000 tons of stone @ $14.50	$218,000
Contingencies	10,000
	$228,000
Engineering and Design	3,000
Supervision and Administration	19,000
Total	$250,000

29. The current cost estimate is greater than the $110,000 allocated and available for rehabilitation of the structure by $140,000. The budget estimate of $110,000 was based on restoring the jetty to its constructed height of +1.5 feet above mean low water and to the constructed cross section area of original jetty. The present design provides for an additional height of 1.5 feet and a flatter side slope of 1 on 1½ to give the jetty more stability through use of heavier stone and reduce maintenance costs. The present design section is considered to be the minimum required to permit use of adequate sized stone; to provide for a better protected entrance channel through reduced wave action and elimination or reduction of tidal flow over the jetty and across the channel which is hazardous to navigation; and to promote scour in the channel with resultant reduction in maintenance dredging cost.

SCHEDULE FOR DESIGN AND CONSTRUCTION

30. Field investigations consisting of profiles and cross-sections were completed in April 1961. Design studies are complete and preparation of plans and specifications are about 70% complete. Invitations for bids are scheduled to be issued 18 May 1962 with bids scheduled to be taken 5 June 1962. Construction is scheduled to begin about 15 July and be completed in 6 months.

31. Funds in the amount of $110,000 have been allocated for rehabilitation in fiscal year 1962. Additional funds in the amount of $140,000 will be required to complete the repairs to the east jetty as designed and recommended.

BENEFITS

32. Benefits were not evaluated at the time the jetties were authorized in 1880 and 1885. The jetties were constructed to provide and maintain an entrance channel of adequate depth to an island community whose entire economy is dependent primarily upon water transportation. Further, the island of Nantucket is located near prolific fishing grounds which contributes to the nations food supply. As a harbor of refuge for the fishing craft at the fishing grounds and the recreational craft in the waters along the coast of Massachusetts and Rhode Island, the value of Nantucket Harbor is unquestioned. Continued provision of a safe entrance channel with adequate depths is therefore paramount.

33. From experience gained at the harbor in 1829-1832 at the time of the initial dredging when the channel is said to have filled in after one storm and the experience gained in maintaining a channel since construction of the jetties, it is certain that a channel could not be maintained at reasonable cost without the jetties. The measure of the value of the benefit of the jetty is therefore the amount of reduction in annual maintenance dredging cost which has been experienced and should be continued. The jetties have been in useful operation more than the usual life of 50 years. The proposed rehabilitation would give better than an additional 50 year of life to the structure. Based on the design proposed it is considered that the average annual cost of maintenance of the rehabilitated structure would be less than experienced on the structure in the past.

34. Commerce in the harbor averages well over 30,000 tons per year consisting principally of fish, gas, oil, lumber and other commodities essential to the economy of an island community. In addition, more than 175,000 passengers and 15,000 automobiles are transported by the ferry connecting the island to the mainland. Vessel trips in and out of the harbor average in excess of 1,500 annually with about 1,100 trips made by vessels with drafts requiring a 15-foot channel.

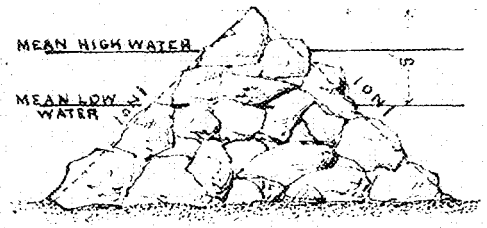
35. The average annual charges for rehabilitating the structure involving the investment of $250,000 at 2-5/8 percent interest for an additional life of 50 years are estimated to be $10,000 including average annual maintenance of $1,000 for repairs to the jetty after rehabilitation.

36. Nantucket Harbor is the only harbor on the island and is essential to the existence to the inhabitants of the island and to the extensive fleets of fishing and recreational craft that use the harbor as refuge. Large ferries plying between Nantucket, Woods Hole and Martha's Vineyard must have unrestricted access to the harbor at all times. Rescue operations by the Brant Point Coast Guard Station are dependent upon adequate channel access to the harbor. Loss of the use of the port would jeopardize life and property in time of storm and would cause collapse of the economy of the island. Repairs to the east jetty are urgently needed to prevent further deterioration and to maintain the effectiveness of the harbor as a refuge and to prevent excessive shoaling in the channel. The average annual charge of $10,000 due to rehabilitation of the structure is considered well justified in view of the benefits to be received through reduced maintenance cost and importance of the channel to the community.

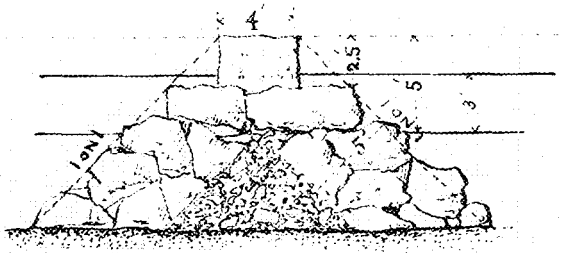
RECOMMENDATION

37. It is recommended that the east jetty at Nantucket Harbor be rehabilitated to the extent provided in the project plan to provide continuous protection at an investment cost of $250,000.

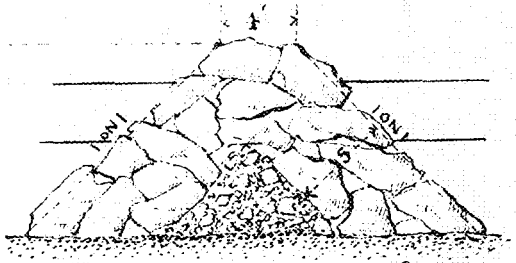
3 Incl
1. Cross-section of original jetties
2. Project Plan
3. Cross-Section of East Jetty (2 shts)



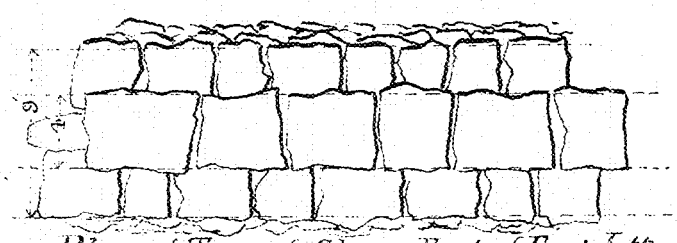
Cross Section Shore End of West Jetty



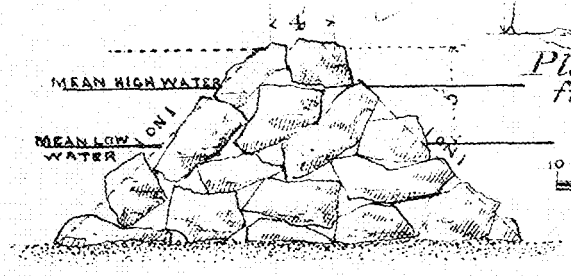
Cross Section Shore End of East Jetty



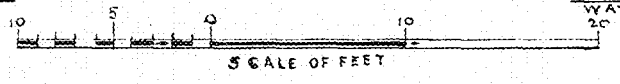
Proposed Full Height Section for remaining portions of both Jetty s

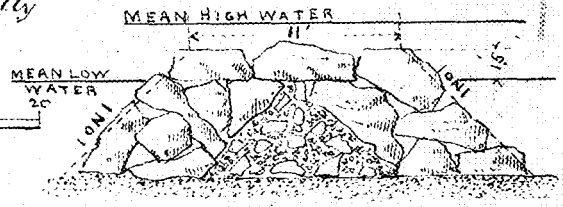


Plan of Top of Shore End of East Jetty from Shore to a point 834ft out



Cross Section West Jetty to a point about 3955ft from Shore





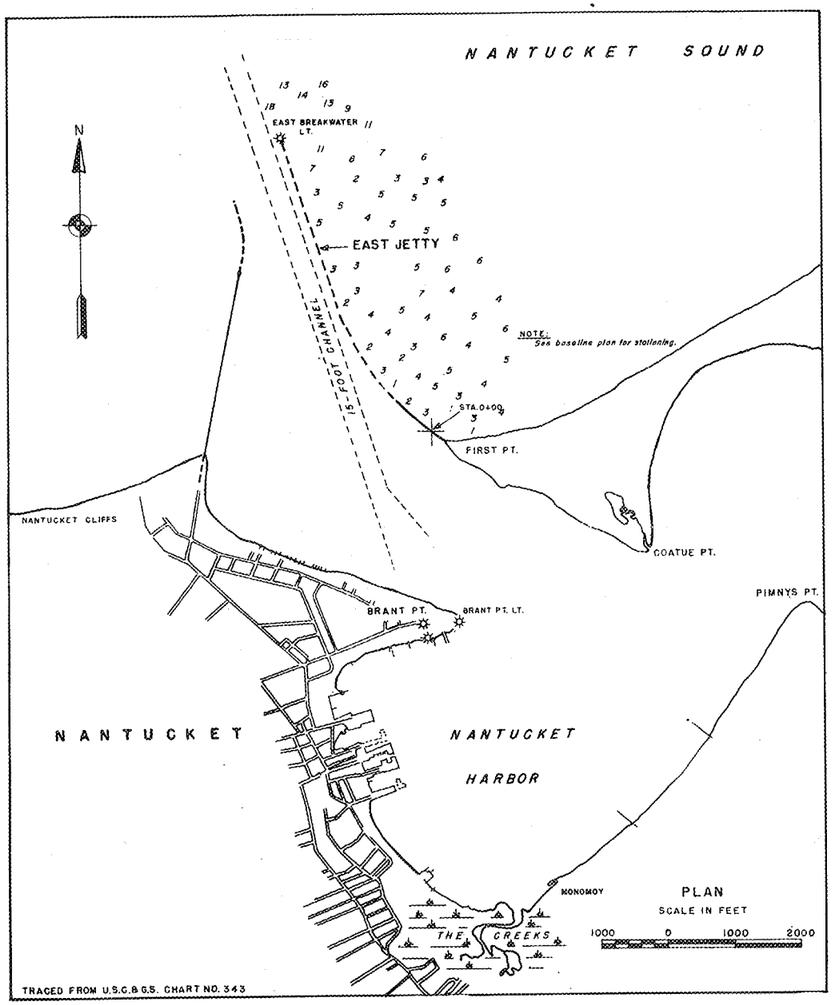
Proposed Half Tide Section for East Jetty beyond a point 2500ft from Shore

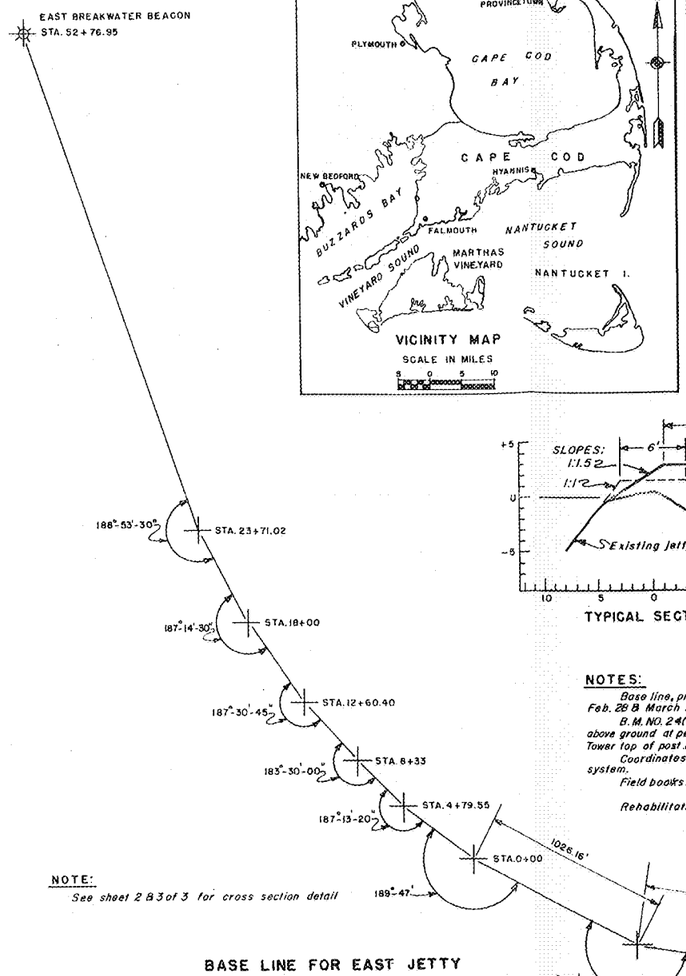
NANTUCKET JETTYS

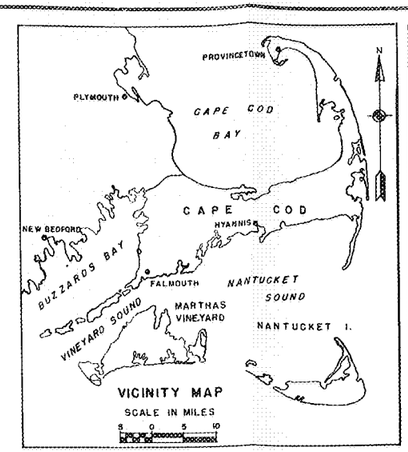
PLATE-1

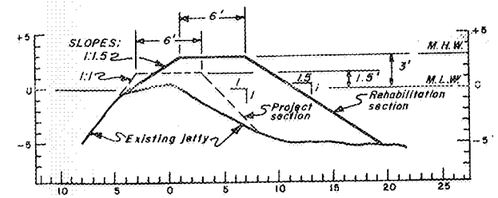
CORPS OF ENGINEERS

U. S. ARMY









TYPICAL SECTION FOR REHABILITATION
SCALE 1" = 5'

NOTES:

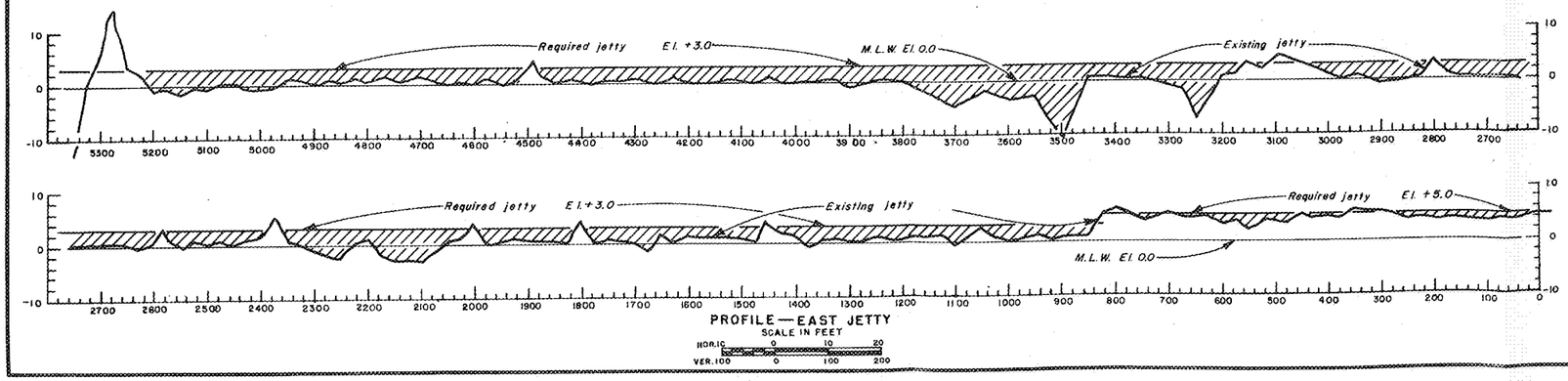
Base line, profiles, and cross sections taken from field surveys dated Feb. 26 & March 7 1961, by J. Gorry.

B.M. NO. 24 (1963). Center of 6" square granite post projecting 6" above ground at pedestrian entrance gate to Brant Point Observation Tower top of post marked U.S.L.H.E.. Elevation above M.L.W. is 8.46 ft..

Coordinates are on the Commonwealth of Massachusetts coordinate system.

Field books: R.& H. 1136, 1606, 1878 & 1879.

Rehabilitation shown thus:



PROFILE — EAST JETTY
SCALE IN FEET
HOR. 100 0 10 20
VER. 100 0 100 200

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY
S.J.B.	S.J.B.	

PROJECT ENGINEER

CHIEF SECTION
SUBMITTED BY
CHIEF, PLANS & SPEC'S BRANCH

APPROVED
CHIEF ENGINEERING DIV.

DATE APRIL 1962

NANTUCKET HARBOR, MASS.

REHABILITATION OF EAST JETTY

To Accompany Design Memo dtd. 1 May '62

SCALE AS SHOWN

SPEC. NO. CIV ENG-19-016-

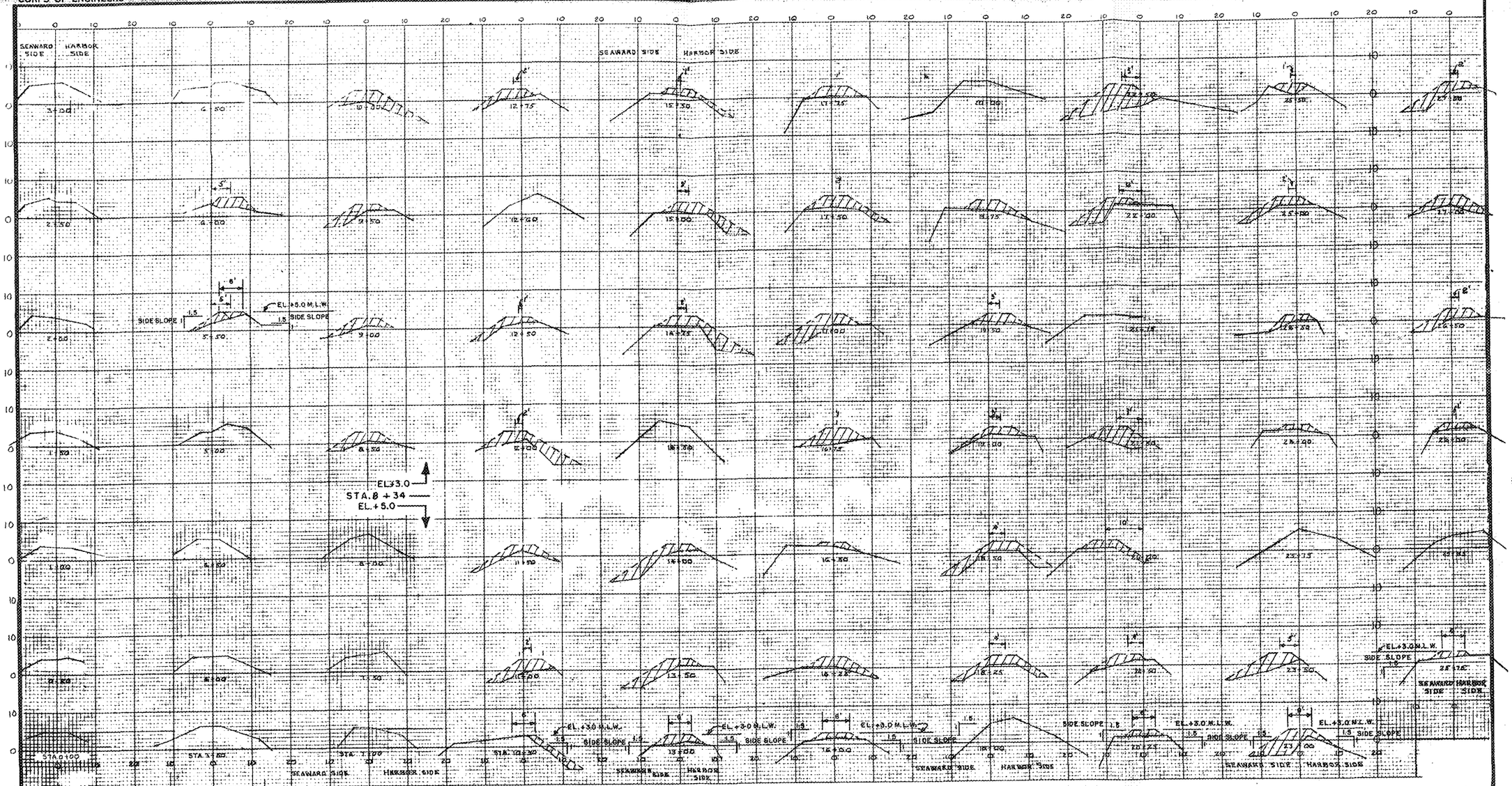
DRAWING NUMBER
NT.-205

SHEET 1 OF 3

PLATE 2

CORPS OF ENGINEERS

U. S. ARMY



CROSS SECTIONS—EAST JETTY

SCALE 1"=10'

NOTE:

Work area shown thus:

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY
S.J.B.	S.J.B.	

NANTUCKET HARBOR, MASS.

REHABILITATION OF EAST JETTY

PROJECT ENGINEER

CHIEF, SECTION

SUBMITTED BY

CHIEF, PLANS & RPTS. BRANCH

APPROVED

CHIEF ENGINEERING DIV.

DATE APRIL 1962

SCALE 1"=10' | SPEC. NO CIV ENG.-18-018-

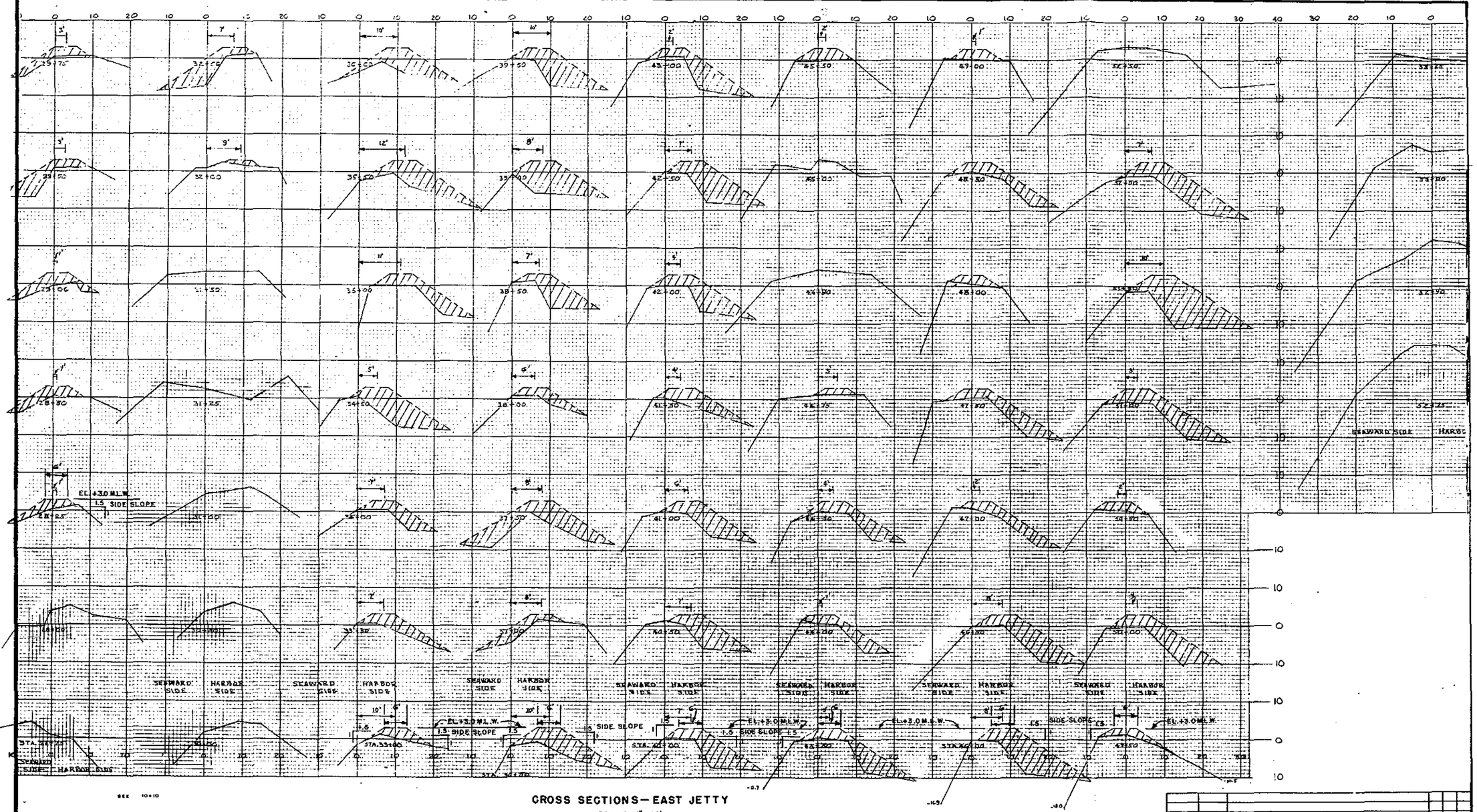
DRAWING NUMBER
Nt.—205

SHEET 2 OF 3

PLATE - 3

CORPS OF ENGINEERS

U. S. ARMY



CROSS SECTIONS—EAST JETTY

SCALE 1"=10'

NOTE:

Work area shown thus:

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY
S.J.B.	S.J.B.	

PROJECT ENGINEER

CHIEF, SECTION

SUBMITTED BY

CHIEF, PLANS & RPTS. BRANCH

NANTUCKET HARBOR, MASS.

REHABILITATION OF EAST JETTY

APPROVED

DATE APRIL 1962

CHIEF ENGINEERING DIV.

SCALE 1"=10' | SPEC. NO. CIV ENG.-19-016-

DRAWING NUMBER
Nt.-205

SHEET 3 OF 3

PLATE-4